STEP GROWTH IN SINGLE-CRYSTAL DIAMOND GROWN BY MICROWAVE PLASMA CHEMICAL VAPOR DEPOSITION

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Abstract

Diamond thin films deposited on natural single crystal diamond substrates have attracted great deal of attention recently[1]. The growth rates of single crystal diamond films are substantially high in a narrow parameter window. Diamond crystals of varying quality are deposited using microwave plasma chemical vapor deposition (MPCVD) system in our laboratory. We use a 2 kW microwave power source coupled into an optimally designed plasma chamber. Unpolished natural diamond seeds are used as substrates in the temperature (T_s) range 950-1200 ^oC. A gas mixture of methane (CH_4), hydrogen (H_2) and nitrogen (N_2) is used for the deposition of diamond. The deposition pressure varied in the range 90 to 150 torr. The films are characterized with scanning electron microscopy (SEM), X-ray diffraction (XRD) and Raman spectroscopy. The growth morphology of the films is a sensitive function of the deposition parameters. The crystalline nature of the films change from polycrystalline to single crystal as we increase T_s and for some parameters the filamentary nature of the diamond crystals can be seen. The films are polycrystalline at T_s in the range of 850 – 900 ^oC and oriented grains of diamond crystals are evident as the T_s increase. The single crystal diamond growth is observed to proceed via the step growth methods with the evidence of bunching of the steps. The study shows that the growth of single crystal diamond proceeds via the step growth process.

References:

1.C.S. Yan, Y.K. Vohra, H.K. Mao and R.J. Hemley, Very high growth rate chemical vapor deposition of single- crystal diamond. *Proc. Natl. Acad. Sci. USA* **99**,12523 (2002)

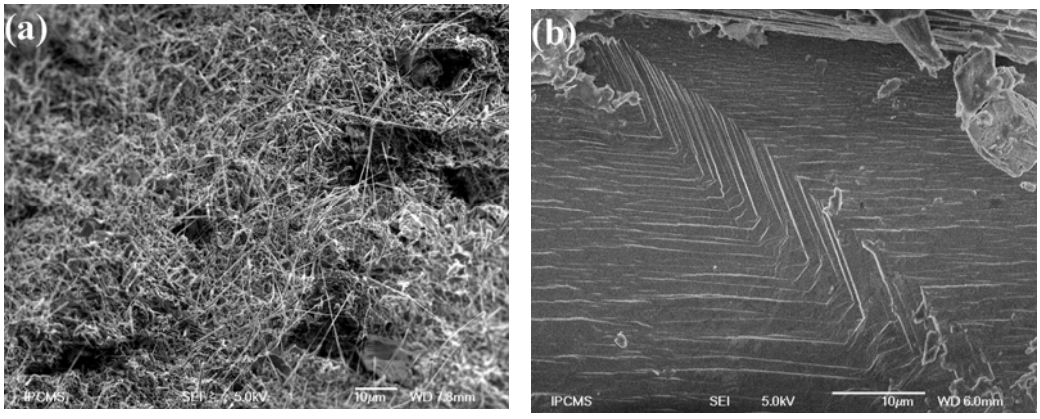

Figure 1:(a) the SEM image of the carbon filament on the surface, Fig (b) shows the step growth in single crystal diamond.